PASSAIC RIVER BASIN
BRANCH OF WEST BROOK,
PASSAIC COUNTY
NEW JERSEY

KITCHELL LAKE DAM
NJ 00026

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

FEBRUARY 1980

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Kitchell Lake Dam, NJ

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

21 JUL

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Kitchell Lake Dam in Passaic County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Kitchell Lake Dam,initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition and the spillway is considered adequate. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The following remedial actions should be completed within twelve months from the date of approval of this report:

(1) Repair all cracked and spalled concrete especially the deteriorated portion of the left abutment wall and the cracks in the left retaining wall of the downstream channel.

(2) All brush and trees should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should then be seeded to develop a growth of grass for surface erosion protection.

b. The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months from the date of approval of this report.

NAPEN-N
Honorable Brendan T. Byrne

c. Within two years from the date of approval of this report, consider providing additional low-level outlet facilities to decrease the draw down time.

d. Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Roe of the Eighth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

KITCHELL LAKE DAM (NJ00026)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 20 November 1979 by Harris-ECI Associates, Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Kitcheli Lake Dam initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition and the spillway is considered adequate. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The following remedial actions should be completed within twelve months from the date of approval of this report:

(1) Repair all cracked and spalled concrete especially the deteriorated portion of the left abutment wall and the cracks in the left retaining wall of the downstream channel.

(2) All brush and trees should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should then be seeded to develop a growth of grass for surface erosion protection.

b. The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months from the date of approval of this report.

c. Within two years from the date of approval of this report, consider providing additional low-level outlet facilities to decrease the draw down time.

d. Within one year from the date of approval of this report the owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

APPROVED: _____

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 20 JUN 80

PASSAIC RIVER BASIN

BRANCH OF WEST BROOK, PASSAIC COUNTY

NEW JERSEY

(10) John P. / Talerico

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KITCHELL LAKE DAM

NJ00026

(11) Feb 80

PHASE I INSPECTION REPORT

(6) NATIONAL DAM SAFETY PROGRAM. Kitchell Lake Dam (NJ00026), Passaic River Basin, Branch of West Brook, Passaic County, New Jersey. Phase I Inspection Report.

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DEPARTMENT OF THE ARMY

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

PHILADELPHIA, PENNSYLVANIA 19106

FEBRUARY 1980

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PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Name:	Kitchell Lake Dam, I.D. NJ 00026
State Located:	New Jersey
County Located:	Passaic County
Stream:	Branch of West Brook
River Basin:	Passaic River
Date of Inspection:	November 20, 1979

Assessment of General Conditions

Kitchell Lake Dam is an earthfill dam containing a concrete weir spillway at the left end of the dam. The overall condition of the dam is good. There is no major sign of distress or instability in the embankment. The upstream toe of the left abutment wall is severely deteriorated. The downstream channel is well defined but has a vertical and horizontal crack in the left retaining wall. The operation of the low-level outlet was demonstrated satisfactorily during the inspection. The hazard potential is recommended to be downgraded to "significant".

The spillway capacity of Kitchell Lake Dam is not considered questionable in view of the ability of the spillway to pass the SDF without overtopping the dam.

At present, the engineering data available is not sufficient to make a definitive statement on the stability of the dam but based on the findings of the visual inspection, the preliminary assessment of static stability is that it is satisfactory. The following actions are recommended along with a timetable for their completion. All recommended actions should be conducted under the supervision of an Engineer who is experienced in the design, construction and inspection of dams.

1. Repair all cracked and spalled concrete especially the deteriorated portion of the left abutment wall and the cracks in the left retaining wall of the downstream channel within twelve months.

2. All brush and trees should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should then be seeded to develop a growth of grass for surface erosion protection. This program should be started within twelve months.

3. The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months.

Furthermore, while of a less urgent nature, the following additional action is recommended and should be carried out within twenty-four months.

1. Consider providing additional low-level outlet facilities to decrease the drawdown time.

2. The owner should develop within one (1) year after formal approval of the report, written operating procedures and a periodic maintenance plan to insure the safety of the dam.

John P. Talerico, P.E.
HARRIS-ECI ASSOCIATES

Photo taken January 21, 1980

K I T C H E L L L A K E D A M

West Brook Road is in left foreground.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the office of theChief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

KITCHELL LAKE DAM, I.D. NJ00026

SECTION 1

1. PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act (Public Law 92-367, 1972) provides for the National Inventory and Inspection Program by the U.S. Army Corps of Engineers. This inspection was made in accordance with this authority under Contract C-FPM No. 35 with the State of New Jersey who, in turn, is contracted to the Philadelphia District of the Corps of Engineers, and was carried out by the engineering firm of Harris-ECI Associates of Woodbridge, N.J.

b. Purpose of Inspection

The visual inspection of Kitchell Lake Dam was made on November 20, 1979. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

The report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the field inspection; presents an evaluation as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

1.2 Description of Project

a. Description of Dam and Appurtenances

Kitchell Lake Dam is an earthfill dam approximately 475 feet long and 14.3 feet high. There is a 55 foot long concrete spillway approximately 100 feet from the left end of the dam. The spillway is a concrete overflow and is part of a concrete core wall that extends 20 feet into the embankment on each side. In the center of the spillway is a 5 foot wide notched weir 3 inches deep. The crest of the spillway is 4 feet below the top of the dam.

The embankment has a top width of 40 feet, and side slopes of 3H:1V upstream and 2H:1V downstream. Riprap is on the upstream face of the embankment and on the approach channel of the spillway. The upstream half of the embankment and the spillway approach channel was constructed with impervious clay fill while the downstream portion was constructed with ordinary earthfill.

The low-level outlet consists of a 12 inch cast iron pipe through the dam located in the center of the spillway. The flow through the pipe is controlled by a manually operated gate valve located in the spillway discharge channel 9 feet from the crest. The inlet end, a concrete headwall, of the pipe is located at the upstream toe of the approach channel. The outlet discharges into the stilling basin 40 feet from the spillway.

An additional 12 inch cast iron pipe is located through the top of the spillway, 5 feet from the left abutment, this is used to lower the lake approximately 2 feet in the fall to prevent ice damage. An iron plate covering the upstream end of the pipe controls the flow.

The downstream spillway channel is 55 feet wide for a distance of 20 feet from the spillway and then narrows to 10 feet where it crosses under West Brook Road approximately 46 feet from the spillway.

There are no known records or logs of the test pits that were taken for the dam's design. The foundation is described as clay and hard pan on the dam's permit.

A generalized description of soil conditions is contained in Report No. 3, Passaic County, Engineering Soil Survey of New Jersey. The report, dated 1951 or during the dam's construction shows Kitchell Lake as a swamp. The surrounding soil is described as shallow ground moraine over rock. The ground moraine in this area is variable in thickness. It is composed of unstratified heterogenous material including clay, silt and sand sizes, with varying amounts of gravel and boulders. The clay and hard pan described on the dam's permit is within this identification. The underlying rock is described on Geologic Overlay Sheet 22 as hornblende granite and gneiss.

b. Location

Kitchell Lake Dam is located on a branch of West Brook in the Township of West Milford, Passaic County, New Jersey. It is accessible by way of West Brook Road.

c. Size Classification

According to the "Recommended Guidelines for Safety Inspection of Dams" by the U.S. Department of the Army, Office of the Chief Engineers, the dam is classified in the dam size category as being "small", since its storage volume of 127 acre-feet is less than 1,000 acre-feet. The dam is also classified as "small" because its height of 14.3 feet is less than 40 feet. The overall size classification of Kitchell Lake Dam is classified as "small" in size.

d. Hazard Classification

A hazard potential classification of "significant" has been assigned to the dam. This is based on the fact there is only one residential structure immediately downstream and it is above the flood reach and although West Brook Road, immediately downstream, is lightly traveled it is part of a school bus route. Therefore the possibility exists of the loss of a few lives in the event of dam failure.

e. Ownership

Kitchell Lake Dam is owned by:

Kitchell Lake Association
Kitchell Lake, R.D. 3
West Milford, NJ 07480

Attention: Mr. Joseph Monaco
(201) 728-7952

f. Purpose

Kitchell Lake Dam is presently used for recreational purposes only.

g. Design and Construction History

A permit to construct Kitchell Lake Dam (then known as Norlan Lake Dam) was issued in September 1948. Construction of the dam was started in October 1948 but was stopped after one month's work due to legal problems. Work was restarted in July 1950 and continued until September 1951 when the property was sold to Mr. W.D. Kitchell. A new permit was issued and construction was completed in August 1952.

In September 1971, a permit was issued to repair the damage caused by Hurricane Doria to the ramp portion of the spillway discharge channel. No other information is on file at the NJ-DEP as to the extent and type of damage caused by the storm. The work involved placing a six inch layer of reinforced concrete over the existing slab.

In November 1979, the upper portion of the upstream right abutment wall was being replaced due to that portion of the wall being severely spalled and tilting in toward the spillway.

h. Normal Operating Procedures

The discharge from the lake is unregulated and is allowed to naturally balance the inflow into the lake. The 12-inch pipe through the spillway crest is used to lower the lake level every fall and to allow property owners to make repairs to their docks and waterfront property.

1.3 Pertinent Data

a. Drainage Area — 0.86 sq. mi.

b. Discharge at Dam Site

Ungated spillway capacity at elevation of top of dam:	1,408 cfs (800 NGVD)
Total spillway capacity at maximum pool elevation (SDF):	1,114 cfs (799.42 NGVD)

c. Elevation (Feet above NGVD)

Top of dam:	800
Maximum pool design surcharge (SDF):	799.42
Recreation pool:	796.2
Spillway crest:	796
Streambed at centerline of dam:	783.5 (estimated)
Maximum tailwater:	786.5 (estimated)

d. Reservoir

Length of maximum pool:	1,800 ft. (estimated)
Length of recreation pool:	1,700 ft. (estimated)

e. Storage (acre-feet)

Spillway Crest:	70
Top of dam:	163
Maximum pool (SDF):	127

f. Reservoir Surface (acres)

Top of dam:	24.8
Maximum pool(SDF)	24.4
Spillway Crest:	22

g. Dam

Type:	Earth fill with concrete weir
Length:	475 ft.(effective)
Height:	14.3 ft.
Top width:	40 ft.
Side slopes - Upstream:	3H:1V
- Downstream:	2H:1V
Zoning:	Upstream portion Impervious clay fill Downstream portion ordinary earthfill
Impervious core:	95 ft. concrete core
Cutoff:	None
Grout curtain:	None

h. Diversion and Regulating Tunnel

N/A.

i. Spillway

Type:	Broad crest concrete weir with shallow notch at center
Length of weir:	55 ft.
Crest elevation:	796 (NGVD)
Gates:	None
U/S Channel:	Kitchell Lake
D/S Channel:	Natural channel with overgrown brush and trees.

j. Regulating Outlets

Low level outlet:		2-12-inch C.I.P.
Controls:	Upper pipe	Manually removable steel plate
	Lower pipe	Manually operated gate valve
Emergency gate:		None
Outlet:	Upper pipe	794 NGVD
	Lower pipe	785.5 NGVD

SECTION 2

2. ENGINEERING DATA

2.1 Design

One drawing for the original construction of Kitchell Lake Dam in 1948 is available at the NJ-DEP. The drawing shows foundation test pits along the dam base. No further embankment data from soil borings, soil tests, design computations, or other geotechnical data are available to assess the embankment stability properly. Some data concerning the hydraulic capacity of the spillway is available.

2.2 Construction

Data is not available concerning the as-built construction of the dam. No data exists of construction methods, borrow sources, or other data pertinent to the construction of the dam.

2.3 Operation

Formal operation records are not kept for the dam and reservoir. The lake is allowed to operate naturally without regulation.

2.4 Evaluation

a. Availability

The availability of engineering data is poor. The stated drawing computations and some correspondence concerning the original construction and the modifications are available from the NJ-DEP.

b. Adequacy

The engineering data available, together with that obtained in the field, were adequate to perform hydrologic and hydraulic computations. The data was insufficient to perform a stability analysis, but preliminary evaluation could be made based on visual observations.

c. Validity

The dam and spillway appear to correspond to the drawing, but the provision for the 12-inch pipe through the spillway crest is not shown. Also the elevations shown on the plan are not based on MSL, but arbitrary datum.

SECTION 3

3. VISUAL INSPECTION

3.1 Findings

a. General

The visual inspection of Kitchell Lake Dam revealed the dam including the spillway to be in good condition but in need of repairs.

At the time of the visual inspection, the lake level was lowered to approximately 6 feet below the spillway for reconstruction of the right abutment wall.

b. Dam

The earth embankment appears to be sound. No misalignment of the horizontal or vertical plane of the embankment was noticed. No riprap failures were noted. No signs of seepage were observed. Trees and brush are growing on the upstream side while some scrub trees and large evergreen trees are along the downstream side of the embankment crest. No evidence of burrowing by animals was observed.

c. Appurtenant Structures

1. Spillway

The concrete weir has spalling on both the upstream and downstream sides along the water level. There are four vertical and two horizontal cracks on the exposed portion of the spillway core wall. The cracks have either been sealed or are tight, but the extent of the depth of the vertical cracks could not be determined. The upper portion of the upstream section of the right abutment wall was in the process of being replaced because the existing was severely deteriorated and was tilting in toward the spillway. The left abutment wall has a slight tilt toward the spillway and upstream portion at the embankment toe has completely deteriorated and eroded out. The horizontal and vertical alignment of the crest is good.

2. Outlet Works

A 12-inch cast iron pipe through the spillway serves as its low-level outlet. The control valve is located in the spillway discharge channel in a cast iron valve box. The valve is manually operated by a valve wrench. The valve was not visible and its condition could not be observed. The valve operated satisfactorily during demonstration.

In addition to the low-level outlet, there is a 12-inch steel pipe through the crest that is used to lower the lake level approximately 2 feet for the winter. The flow is controlled by a steel plate covering the inlet end of the pipe. The pipe is skewed through the crest so that the discharge runs along the left abutment and channel wall. The flow was causing scouring along the base of the wall and a 9-inch wide concrete curb was placed at the outlet end of the pipe to deflect the flow into the center of the channel. The entire system was in good condition.

d. Reservoir Area

Houses, boat landings and trees circle the lake. The side slopes of the lake are flat to moderately steep. The lake was clear with no growth of algae.

e. Downstream Channel

The downstream channel from the spillway to West Brook Road is contained within two concrete retaining walls. The junction between the spillway abutment walls and the retaining walls have been patched. The left retaining wall has a vertical crack and a horizontal crack that show signs of seepage from the ground water. The channel bottom has minor spalling by the left retaining wall and a longitudinal crack at the approximate center of the channel.

The 4-inch weep holes located in the downstream channel bottom to prevent uplift were unclogged and in good condition.

Beyond the West Brook Road, the channel is densely overgrown with small trees and brush. The slopes are flat. There is one house on the left bank of the lake approximately 500 feet from the road. The house is situated well above the flood plain.

SECTION 4

4. OPERATIONAL PROCEDURES

4.1 Procedures

Kitchell Lake Dam is used to impound water for recreational activities. The level of the lake is maintained through the unregulated flow over the spillway. The lake is lowered 2 feet every autumn to prevent ice damage to lake side property, and is periodically lowered to allow property owners to make repairs to their properties.

4.2 Maintenance of the Dam

There is no regular inspection and maintenance program for the dam and appurtenant structures. The Kitchell Lake Association is responsible for the maintenance of the dam.

4.3 Maintenance of Operating Facilities

The low-level outlet operating facilities consist of the one manually operated 12-inch gate valve and a removable steel plate at the inlet end of the upper 12-inch pipe. At the time of inspection, operation of the valve was satisfactorily demonstrated.

4.4 Evaluation

The present operational and maintenance procedures are fair with the dam and spillway being maintained in a serviceable condition.

SECTION 5

5. HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The drainage area above Kitchell Lake Dam is approximately 0.86 square miles. A drainage map of the watershed of Kitchell Lake dam site is presented on Plate 1, Appendix D.

The topography within the basin is generally moderately sloped. Elevations range from approximately 1,180 feet above NGVD at the south end of the watershed to about 800 feet at the dam site. Land use patterns within the watershed are mostly rural, with concentrated residential development around the lake area.

The evaluation of the hydraulic and hydrologic features of Kitchell Lake was based on criteria set forth in the Corps Guidelines and additional guidance provided by the Philadelphia District, Corps of Engineers. The SDF for the dam falls in a range of 100-year Flood to 1/2 PMF. In this case the low end of the range, 100-year Flood, is chosen since the factors used to select size and hazard classification are on the low-side of their respective ranges.

The 100-year Flood was calculated from 100-year precipitation using National Weather Service Hydro-35 Technical Paper No. 40. Due to the small drainage area, the SCS triangular hydrograph transformed to a curvilinear hydrograph was adopted for developing the unit hydrograph, with the aid of the HEC-1DB Flood Hydrograph Computer program.

Initial and infiltration loss rates, were applied to the 100-year rainfall to obtain rainfall excesses. The rainfall excesses were applied to the unit hydrograph to obtain the 100-year Flood hydrograph utilizing program HEC-1DB.

The SDF peak outflow calculated for the dam is 1,114 cfs. The value is derived from the 100-year flood, assuming that the lake was originally at spillway crest elevation. The 100-year flood was routed through the dam and it was found the dam would not overtop.

The reservoir stage-storage capacity relationship was computed directly by the conic method, utilizing the HEC-1DB program. The reservoir surface areas at various elevations were measured by planimeter from U.S.G.S. Quadrangle topographic map. Reservoir storage capacity included surcharge levels exceeding the top of the dam, and the spillway rating curve was based on the assumption that the dam remains intact during routing.

Breach analysis is not required since the spillway capacity is adequate.

Drawdown calculations indicate that to empty the lake to an elevation of 786.5 NGVD through the two low-level outlets would take 4 days, assuming a 2 cfs/square mile inflow. This is considered to be an excessive drawdown period, and provision of additional outlets should be considered.

b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site.

c. Visual Observation

The natural channel below the dam is overgrown with brush and small trees, and there are no dwellings immediately downstream of the dam.

The slopes of the reservoir are moderate to steep and do not exhibit signs of instability. The drainage area is wooded, moderately flat sloped and developed for residential use around the lake.

d. Overtopping Potential

As indicated in Section 5.1 a, the spillway capacity of Kitchell Lake Dam is considered to be adequate. There is no overtopping potential at 100-year flood.

SECTION 6

6. STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There are no major distress signs in the embankment of the Kitchell Lake Dam. Trees growing on the crest and upstream slope could pose a threat to stability. The spillway is in good condition but shows signs of stress and deterioration. Four vertical and two horizontal cracks exist on the spillway portion of the concrete core wall. The vertical cracks are visible down to the channel apron but their extent below it could not be determined. All visible cracks have been sealed or are tight. The upper portion of the upstream right abutment wall was in the process of being replaced because of severe deterioration and tilting towards the spillway. The left abutment had a slight tilt outwards and its upstream portion was deteriorated and eroded out at the toe. The left retaining wall for the downstream channel has a vertical and a horizontal crack that show signs of ground water seepage.

b. Design and Construction Data

No design computations relating to stability were uncovered during the report preparation phase. No embankment or foundation soil parameters are available for carrying out a conventional stability analysis on the embankment.

c. Operating Records

No operating records are available relating to the stability of the dam.

d. Post Construction Changes

A 6-inch thick reinforced concrete layer was placed over the existing ramp portion of the discharge channel in 1971. The upper portion of the upstream existing right abutment wall was being rebuilt at the time of the inspection and was completed in November 1979.

e. Static Stability

A static stability analysis was not performed for Kitchell Lake Dam because the lack of data on which to base assumptions of materials properties inside embankment zones might produce misleading results. The recommended remedial actions must be implemented in order to decrease the risk of local failure, but based on the findings of the visual inspection, the preliminary assessment of static stability is that it is satisfactory.

f. Seismic Stability

The dam is located in Seismic Zone 1, as defined in Recommended Guidelines for Safety Inspection of Dams, prepared by the Corps of Engineers. In general, projects located in Seismic Zones 0, 1 and 2 may be assumed to present no hazard from earthquake, provided the static stability conditions are satisfactory and conventional safety margins exist. Since static stability safety factors have not been confirmed, it cannot be stated that seismic stability is satisfactory.

SECTION 7

7. ASSESSEMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

The dam has been inspected visually and a review has been made of the available engineering data. This assessment is subject to the limitations inherent in the visual inspection procedures stipulated by the Corps of Engineers for a Phase I report.

The adequacy of Kitchell Lake Dam is not in question because the dam does have adequate spillway capacity to pass the 100-year flood which is the SDF for the dam, without overtopping.

No definitive statement pertaining to the safety of the embankment can be made without acquisition of embankment and foundation material engineering properties, but based on the findings of the visual inspection, the preliminary assessment of static stability is that it is satisfactory.

b. Adequacy of Information

The information uncovered was adequate to perform hydrologic and hydraulic computations. The data was insufficient to perform even an approximate computation of the stability of the dam. A preliminary assessment of the dam could be made by visual observation only.

c. Urgency

The existing dam plans and drawings should be annotated and updated to form a coherent as-built set within twelve months.

7.2 Remedial Measures

a. Alternatives for Increasing Spillway Capacity

Alternatives for increasing spillway capacity are not necessary as it is adequate to handle the SDF.

b. Recommendations

1. Repair all cracked and spalled concrete especially the deteriorated portion of the left abutment wall and the cracks in the left retaining wall of the downstream channel within twelve months.

2. All brush and trees, should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should then be seeded to develop a growth of grass for surface erosion protection. This program should be started within twelve months.

The following additional actions are recommended:

1. The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months.

2. Consider providing additional low-level outlet facilities to decrease the drawdown time.

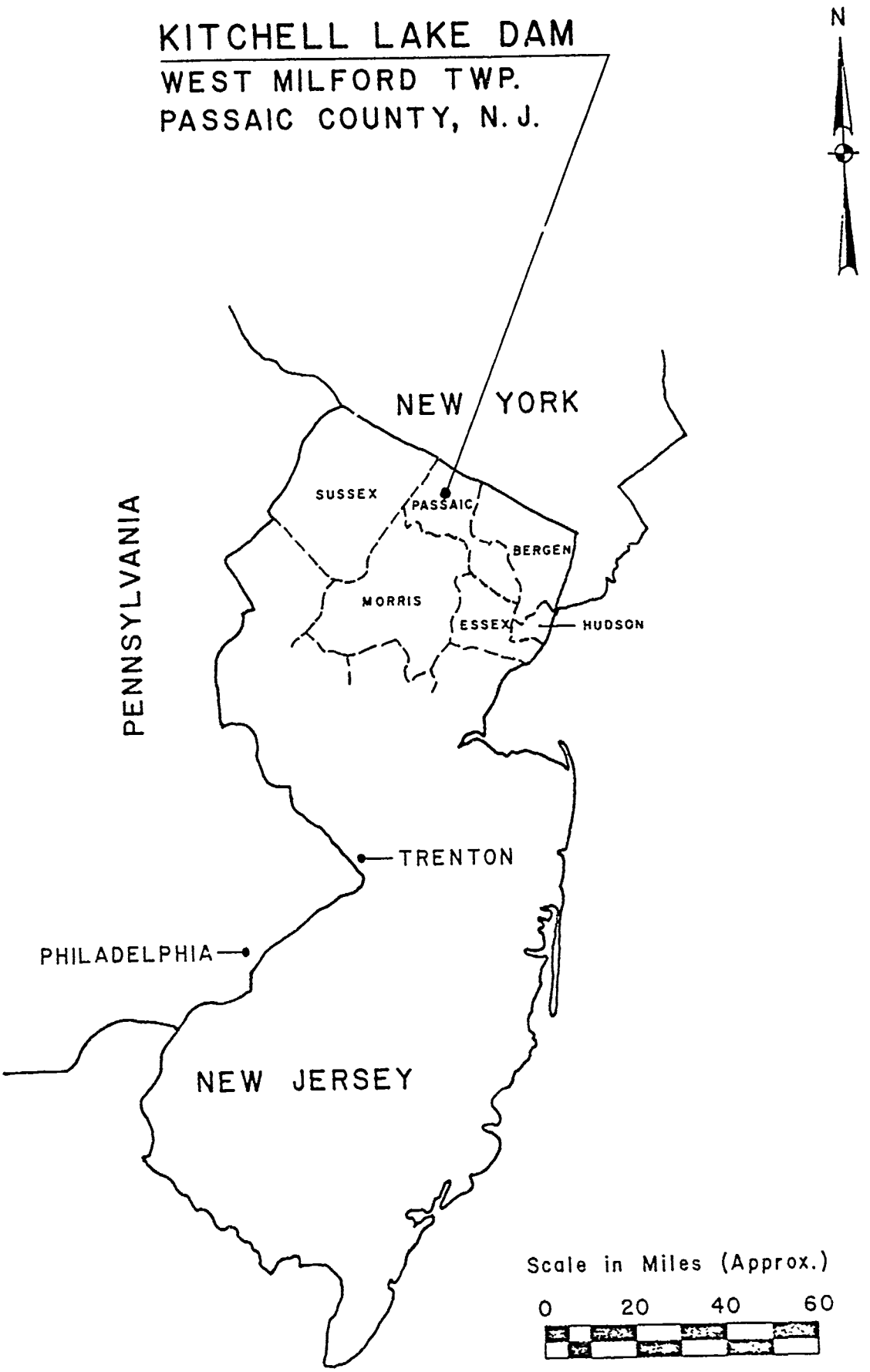
3. The hazard potential classification for Kitchell Lake should be downgraded to "significant" since a hypothetical failure would result in the loss of no more than a few lives.

c. O & M Procedures

The owner should develop, within one (1) year after formal approval of the report, written operating procedures and a periodic maintenance plan to insure the safety of the dam.

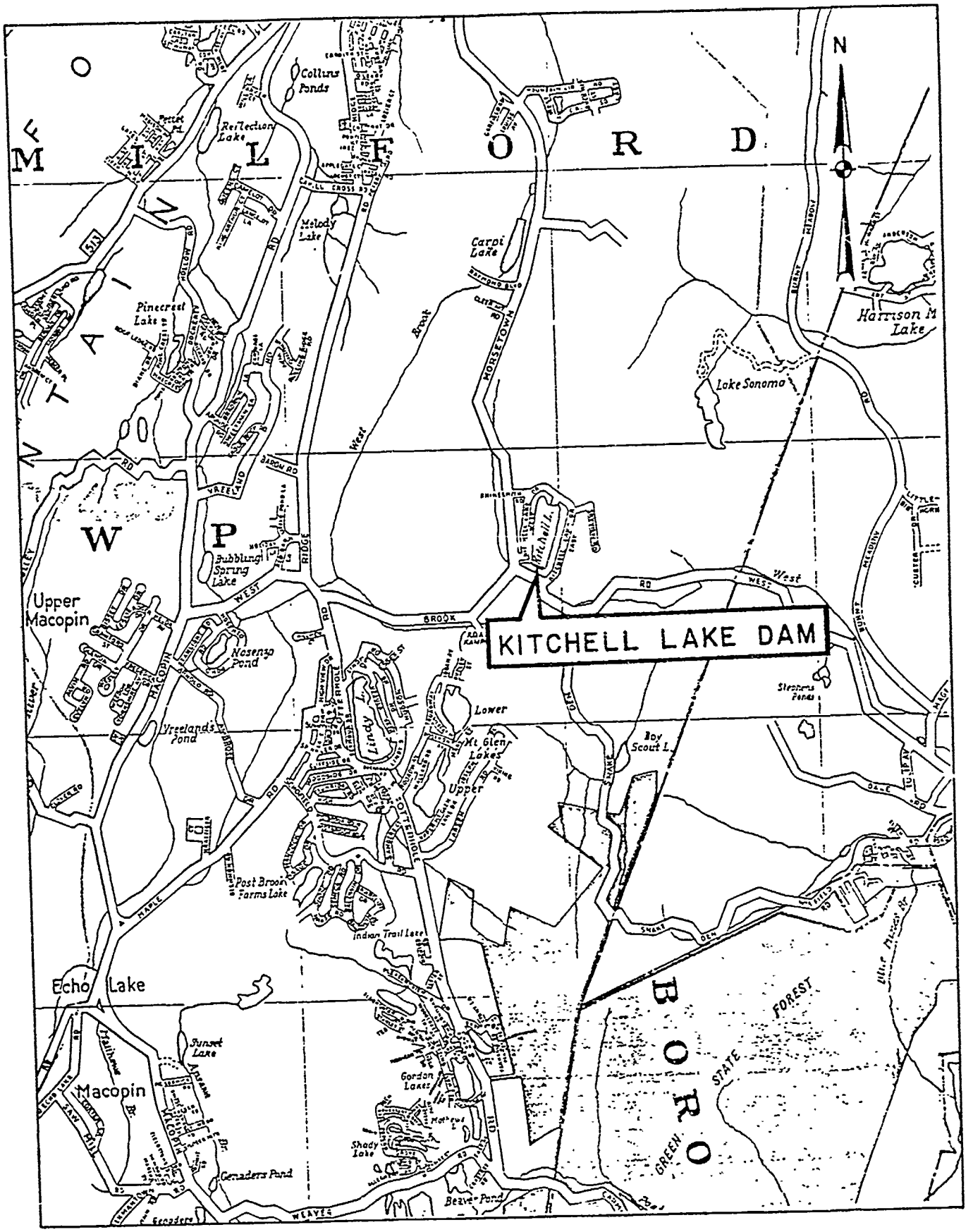
PLATES

KITCHELL LAKE DAM
WEST MILFORD TWP.
PASSAIC COUNTY, N.J.



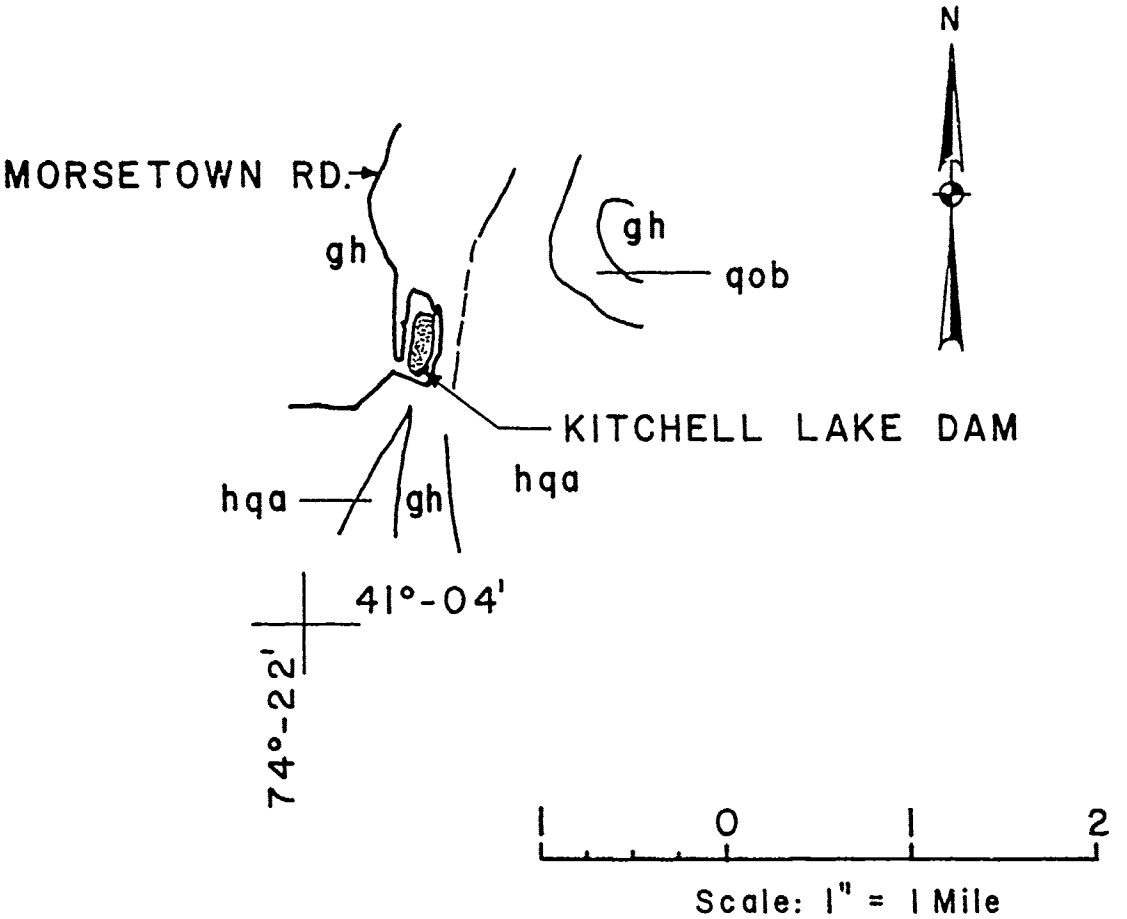
KEY MAP

PLATE I



VICINITY MAP

PLATE IA



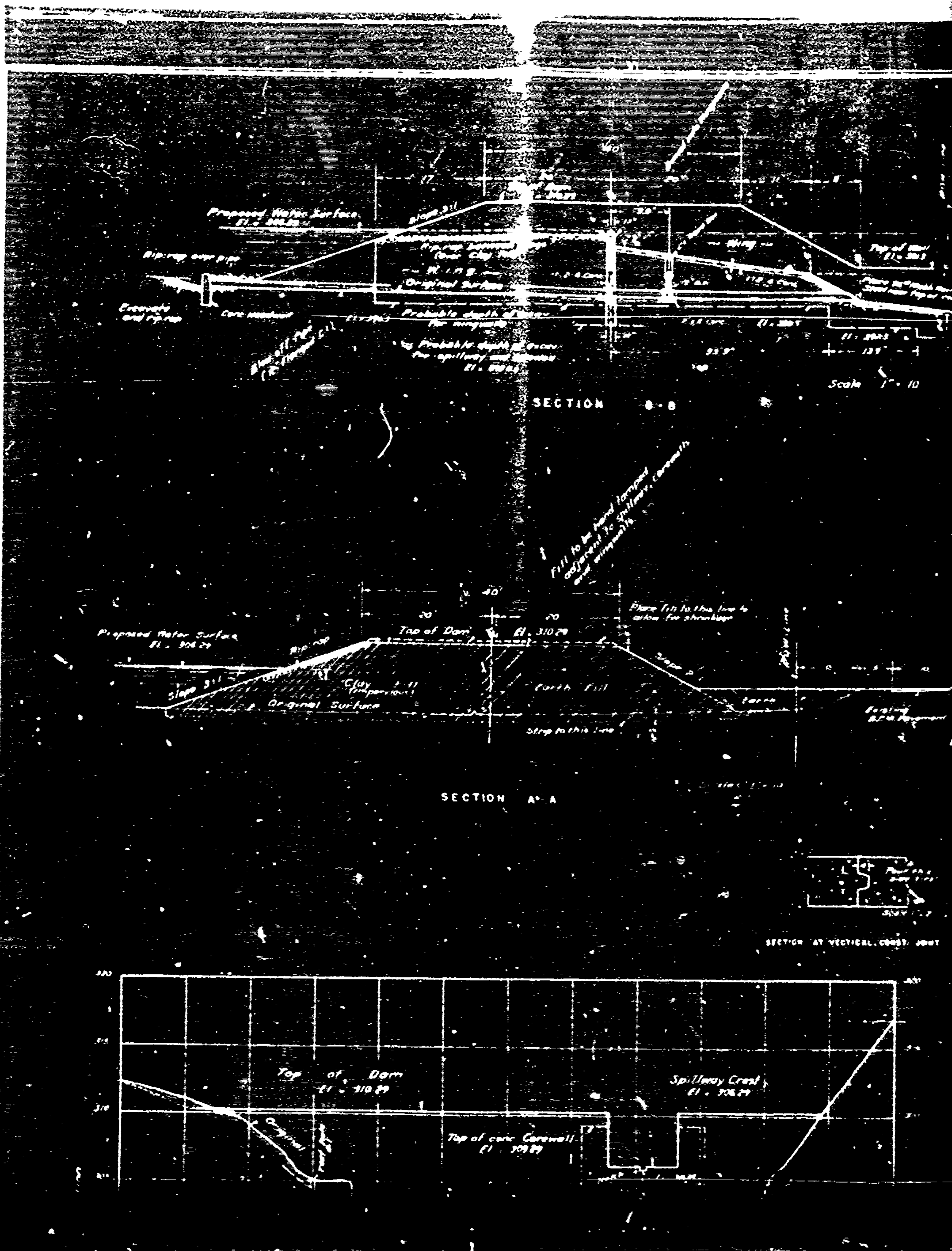
LEGEND:

PRECAMBRIAN

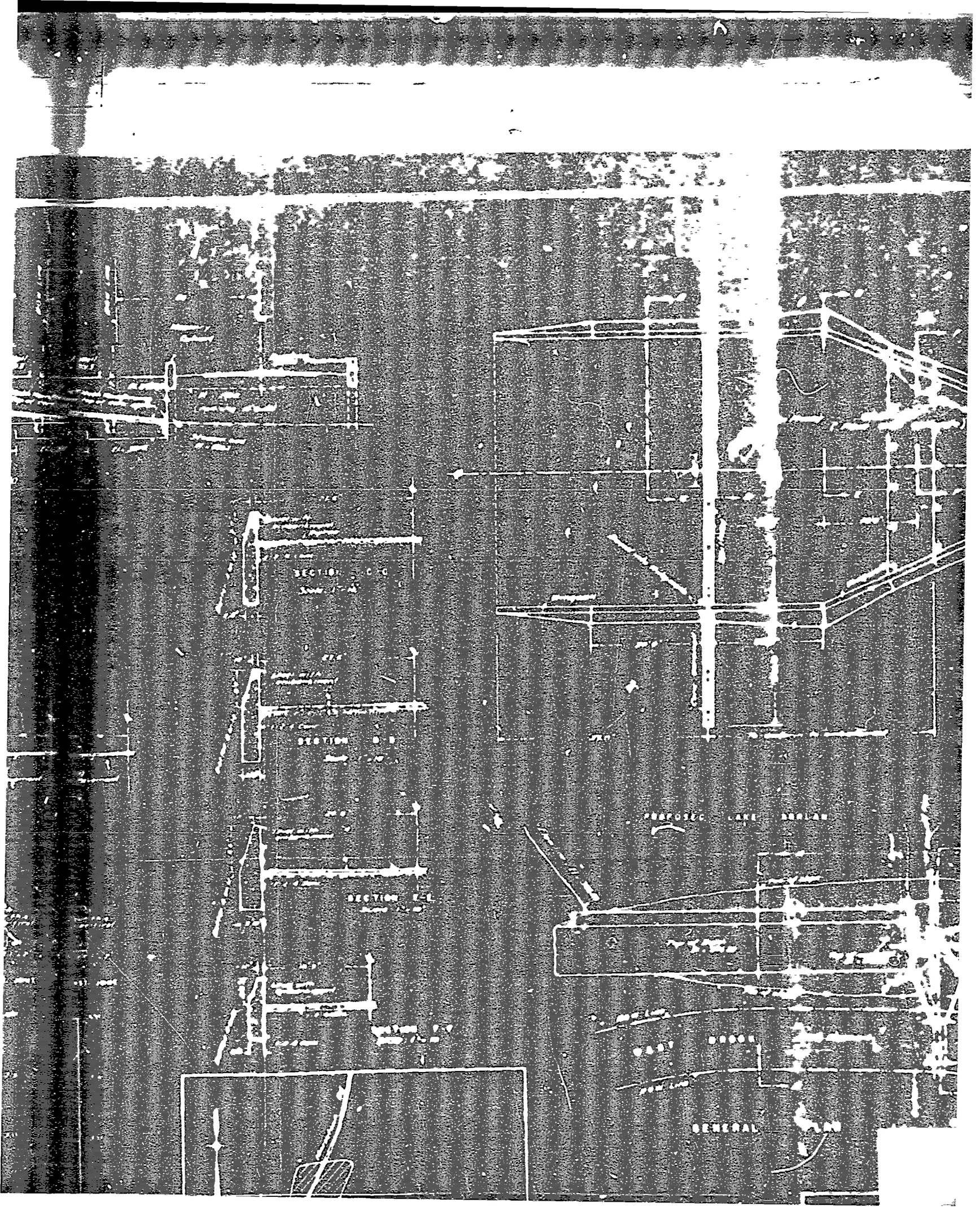
gh	Mostly Hornblende Granite and Gneiss.
hqa	Hyperstene-Quartz-Andesine-Gneiss.
qob	Quartz-Oligoclase-Biotite Gneiss.
----	Contact

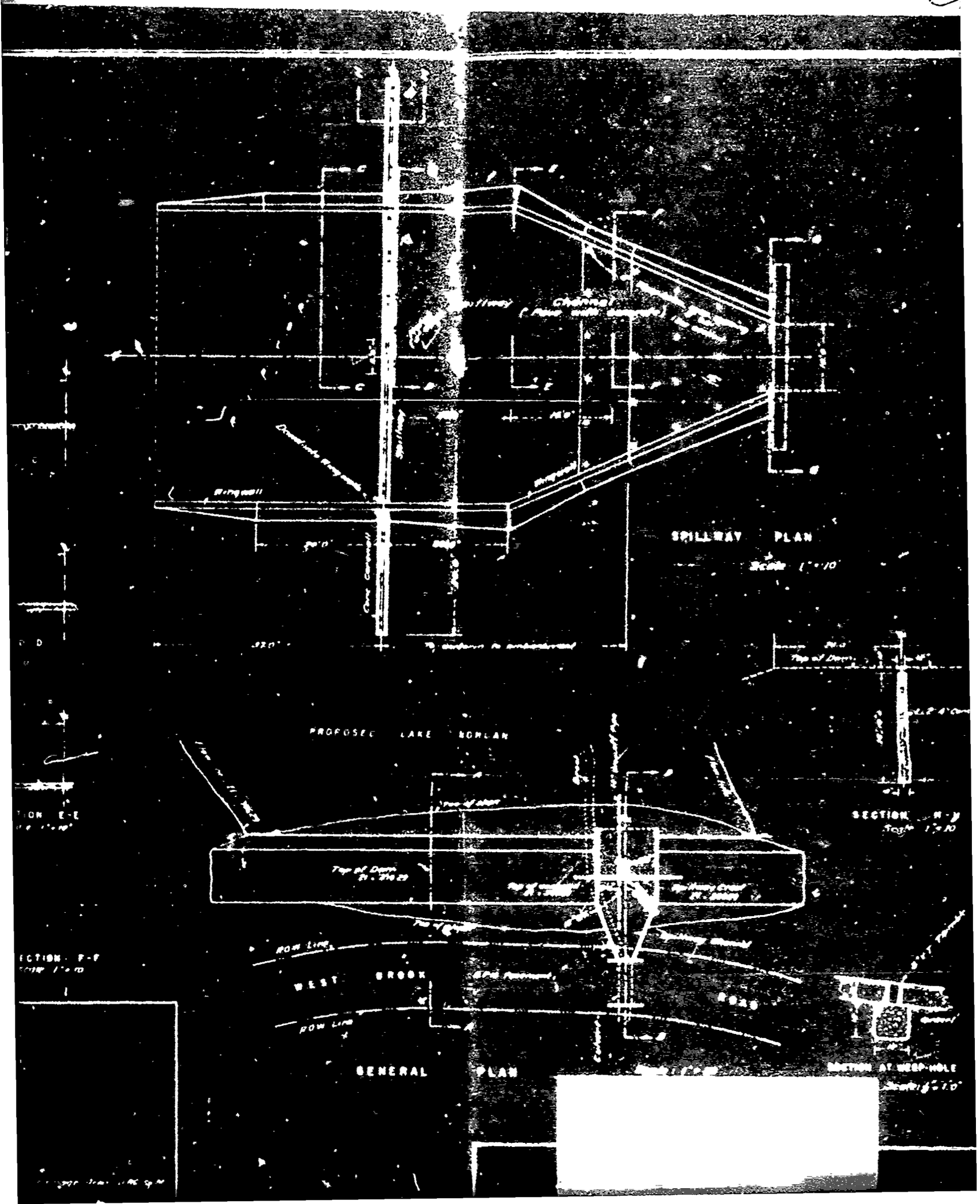
GEOLOGIC MAP
KITCHELL LAKE DAM

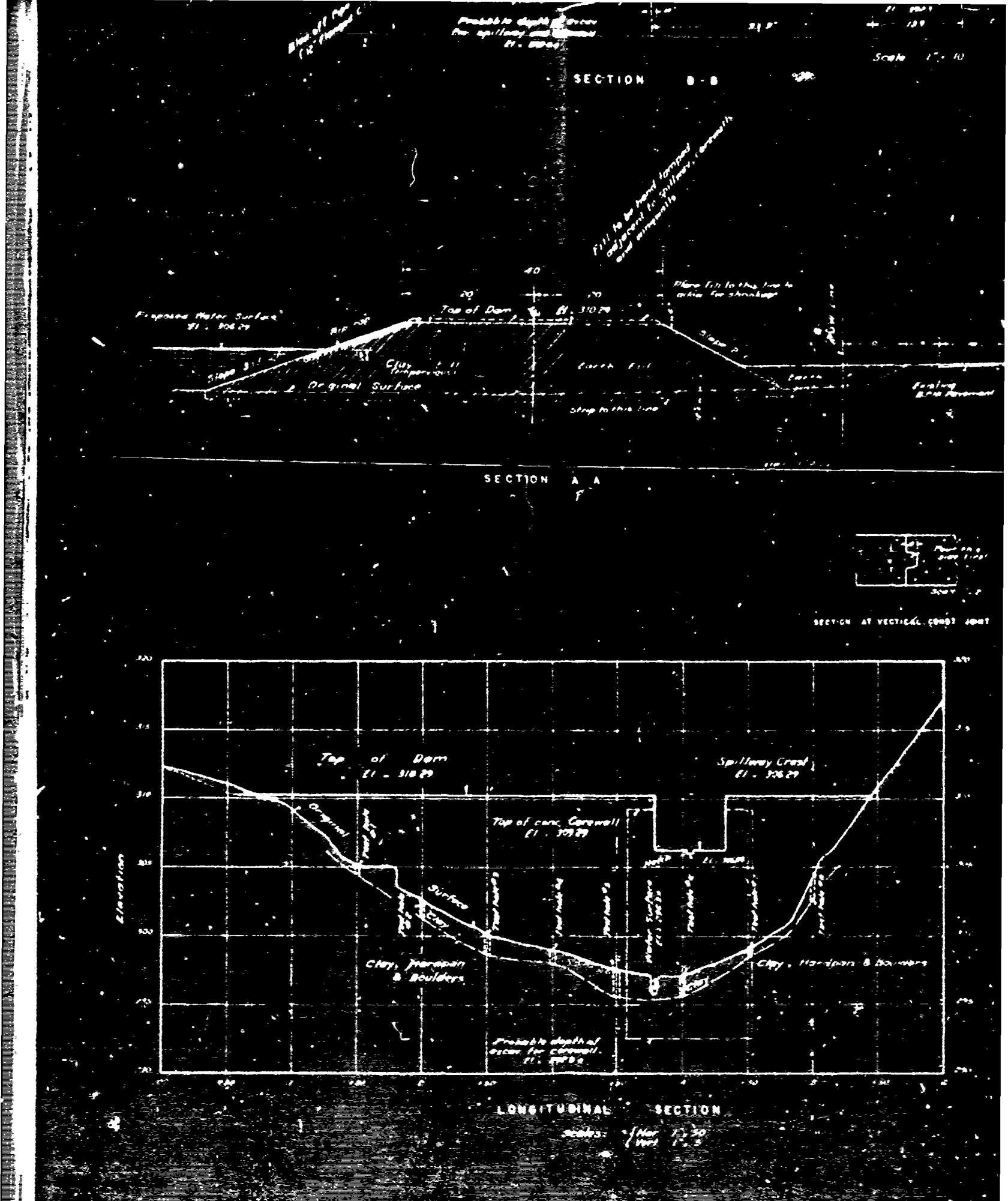
PLATE 2

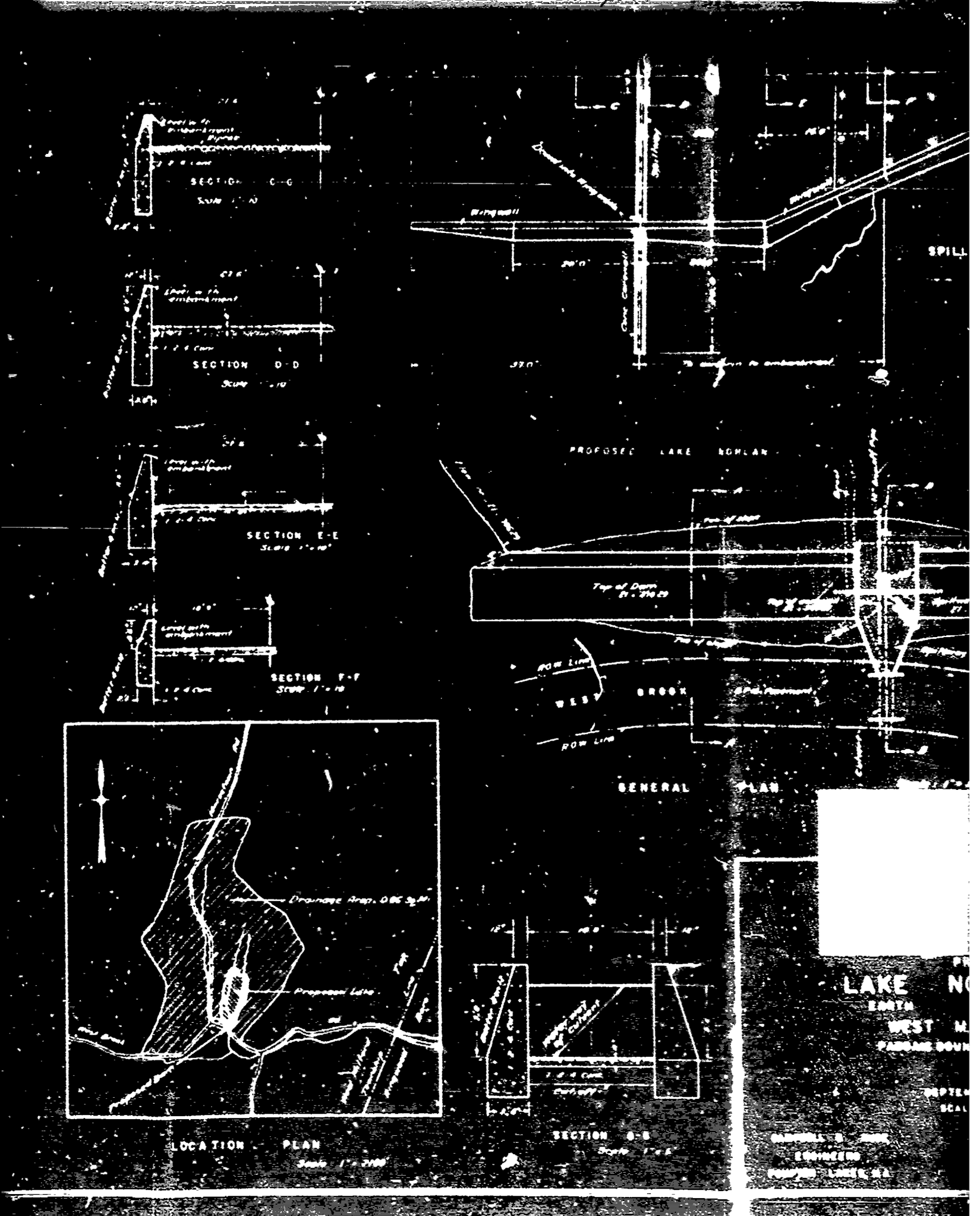


Proposed Water Surface
Rip-rap over pipe
Excavate and rip-rap
Original Surface
Probable depth of excav. for spillway and
Scale 1" = 10
SECTION B-B
Fill to be hand tamped adjacent to Spillway, corewalls and wingwalls
40'
20'
20
Place fill to this line to allow for shrinkage
Proposed Water Surface
Top of Dam
El. 310.29
Clay (Impervious)
Earth Fill
Original Surface
Strip to this line
Existing
SECTION A-A
SECTION AT VERTICAL CONST. JOINT
320
315
310
Top of Dam
El. 310.29
Spillway Crest
El. 306.29
Original
Top of conc Corewall

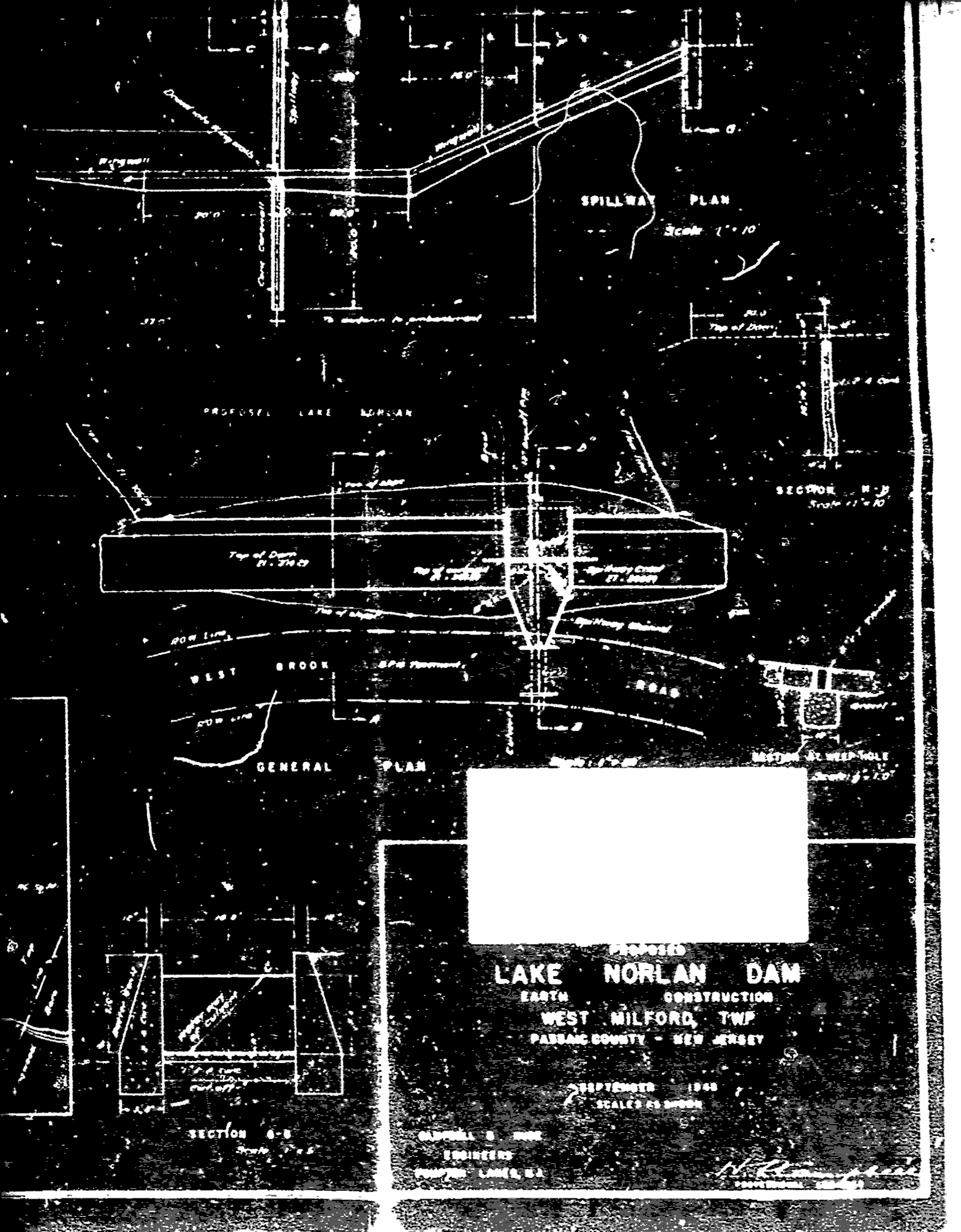



SPILLWAY PLAN
PROPOSED LAKE NORLAN
WEST BROOK
ROW LINE
ROW LINE
GENERAL PLAN


SECTION B-B
Top of Dam
Original Surface
SECTION A A
SECTION AT VERTICAL CONST JOINT
Top of Dam
Spillway Crest
Top of conc. Cutwall
Clay, Hardpan & Boulders
LONGITUDINAL SECTION



KITCHELL LAKE DAM
(FORMERLY LAKE NORLAN D



KITCHELL LAKE DAM PLATE 3

(FORMERLY LAKE NORLAN DAM)

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION MAINTENANCE DATA

CHECK LIST
VISUAL INSPECTION
PHASE 1

Name Dam KITCHELL LAKE DAM County Passaic State New Jersey Coordinators NJ-DEP

Date(s) Inspection November 20,1979 Weather Partly Cloudy Temperature 60°F

Pool Elevation at Time of Inspection 794 NGVD Tailwater at Time of Inspection * NGVD

Inspection Personnel:

November 20, 1979

Chuck Chin
Henry King
Thomas Lakovich
Joseph Sirianni (Recorder)

Owner/Representative:
Louis Spinelli
Joseph Monaco
Kitchell Lake Association
Kitchell Lake R.D. 3
West Milford, NJ 07480

* At the time of inspection, the lake was lowered for repairs to the existing right abutment wall.

The downstream channel was dry.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SEEPAGE OR LEAKAGE N/A		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS N/A		
DRAINS N/A		
WATER PASSAGES N/A		
FOUNDATIONS N/A		

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES N/A		
STRUCTURAL CRACKING N/A		
VERTICAL & HORIZONTAL ALIGNMENT N/A		
MONOLITH JOINTS N/A		
CONSTRUCTION JOINTS N/A		

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SURFACE CRACKS None observed		
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE No visible movement of cracking at or beyond toe was noticed.		
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES None		
VERTICAL & HORIZONTAL ALIGNMENT OF THE CREST Good		
RIPRAP FAILURES None		

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
Earth embankment	has many trees and bushes near crest of upstream slope. Some scrub trees and large evergreens downstream side of crest.	Remove trees.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Upper portion of the upstream right abutment wall in process of being replaced due to heavy spalling and tilting towards spillway. Left abutment wall has slight tilt toward spillway. Upstream portion of abutment wall toe has eroded out.	Repair left abutment wall.
ANY NOTICEABLE SEEPAGE	None noticed.	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CRACKING & SPALLING OF CONCRETE SURFACES IN STILLING BASIN See "Ungated Spillway".		
INTAKE STRUCTURE Bottom low-level drain under water in lake. Not visible. Inlet end of the Upper low-level pipe in good condition.		
OUTLET STRUCTURE Bottom low-level drain (12-inch cast iron pipe) discharges directly in spillway discharge channel. Good condition. The valve operated satisfactorily during demonstration. Upper low-level drain(12-inch cast iron pipe)discharges at base of spillway onto the discharge apron. Pipe in good condition.		
OUTLET FACILITIES None		
EMERGENCY GATE None		

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE WEIR	Spalling near crest of both upstream and downstream face of weir. Four vertical structural and two horizontal cracks. Cracks are either tight or have been sealed.	
APPROACH CHANNEL	Riprap in good condition.	
DISCHARGE CHANNEL	Minor spalling of channel bottom, a longitudinal crack along approximate centerline of channel. Left channel retaining wall has a vertical and horizontal crack (beyond toe of slope) that show signs of seepage.	Repair cracks in retaining wall.
BRIDGE AND PIERS	None	
DRAINS	Drains are in bottom of the concrete discharge channel to prevent uplift. Drains operated satisfactorily	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES & OPERATION EQUIPMENT	N/A	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
MONUMENTATION/SURVEYS None		
OBSERVATION WELLS None		
WEIRS None		
PIEZOMETERS None		
OTHER None		

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SLOPES	Flat to moderate. No indication of slope instability.	
SEDIMENTATION	Major inflow brings sand and stones into lake and deposits them at entrance creating a sand bar. No sedimentation of any degree in lake.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.) Densely overgrown with small trees and brush.		
SLOPES Flat		
APPROXIMATE NUMBER OF HOMES AND POPULATION One house on lake's left bank, approximately 500 feet from West Brook Road, high above flood plain. Owner states approximately 200 cars a day use the road, and road is part of school bus route.		

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available on microfilm at N.J. Department of Environmental Protection (NJ-DEP), 1474 Prospect Street, P.O. Box CN-029, Trenton, NJ 08625.
REGIONAL VICINITY MAP	Available - Passaic County Map and U.S.G.S. Quadrangle Sheet for Wanaque, N.J.
CONSTRUCTION HISTORY	No formal history exists, but can be deduced from the available microfilm at NJ-DEP.
TYPICAL SECTIONS OF DAM	Available on microfilm at NJ-DEP.
HYDROLOGIC/HYDRAULIC DATA	Not available.
OUTLETS - PLAN	Available on microfilm at NJ-DEP(12-inch pipe through crest not shown).
- DETAILS	Available on microfilm at NJ-DEP(12-inch pipe through crest not shown).
- CONSTRAINTS	None
- DISCHARGE RATINGS	Not available
RAINFALL / RESERVOIR RECORDS	Not available

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	Available U.S.G.S. Geologic Overlay Sheet for Passaic County and Engineering Soils Survey of New Jersey, Report No. 3-Passaic County, by Rutgers University(New Brunswick, N.J.).
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None available.
BORROW SOURCES	Unknown.
SPILLWAY PLAN - SECTIONS - DETAILS	Available on microfilm at NJ-DEP.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
OPERATING EQUIPMENT PLANS AND DETAILS	None available.
MONITORING SYSTEMS	None available.
MODIFICATIONS	Resurfaced ramp portion of spillway discharge channel in 1976. Rebuilt existing upstream portion of right abutment wall in 1979.
HIGH POOL RECORDS	Not kept.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available.
PRIOR ACCIDENTS OF FAILURE OF DAM - DESCRIPTION - REPORTS	None known to exist.
MAINTENANCE OPERATION RECORDS	None known to exist.

APPENDIX B

PHOTOGRAPHS

(Taken on November 20, 1979 and
January 21, 1980)

Photo 1 - View looking towards spillway and lake.
(Photo taken on November 20, 1979)

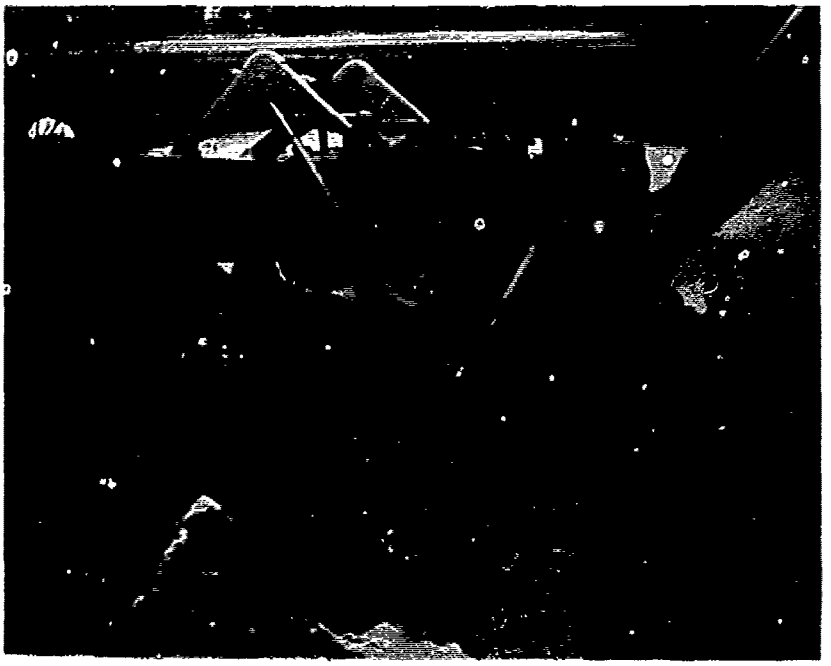


Photo 2 - Detail showing construction in process to replace the upper portion of the right abutment. That portion of the wall is being replaced due to its tilting toward the spillway and because of heavy spalling.
(Photo taken on November 20, 1979)

Photo 3 - View of right abutment and earth embankment. Lake is out of photo to viewer's right. Repair to abutment wall is described in Photo 2. (Photo taken on November 20, 1979)

Photo 4 - View of right abutment and upstream side of embankment. Note trees on embankment. Repair to abutment is described in Photo 2. (Photo taken on November 20, 1979)

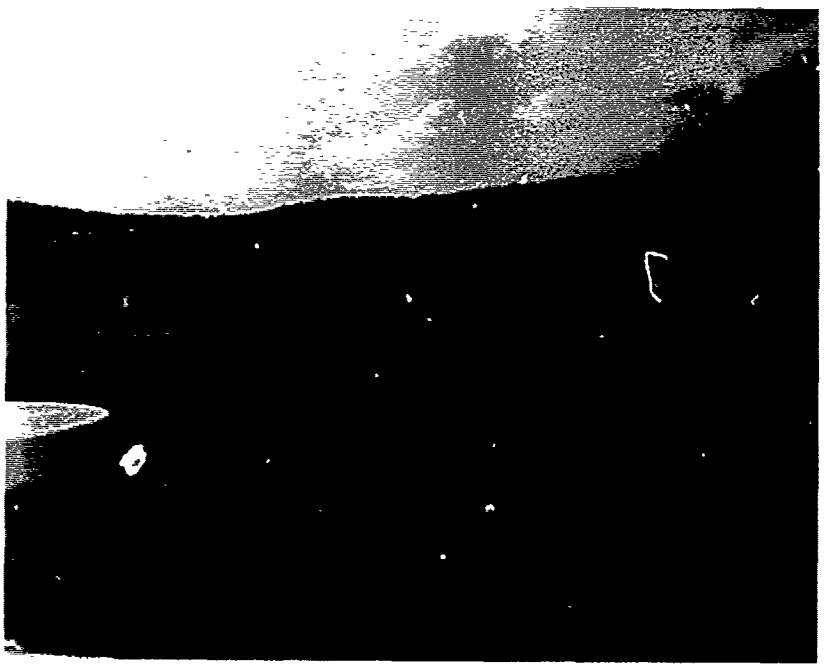


Photo 5 - View looking upstream of spillway in foreground and approach channel, lined with riprap, beyond spillway. (Photo taken on November 20, 1979)

Photo 6 - View of lake from spillway.
(Photo taken on November 20, 1979)

Photo 7 - View of left approach channel retaining wall. Note repaired horizontal crack and erosion at its toe. Spillway is out of photo to viewer's right. (Photo taken on November 20, 1979)

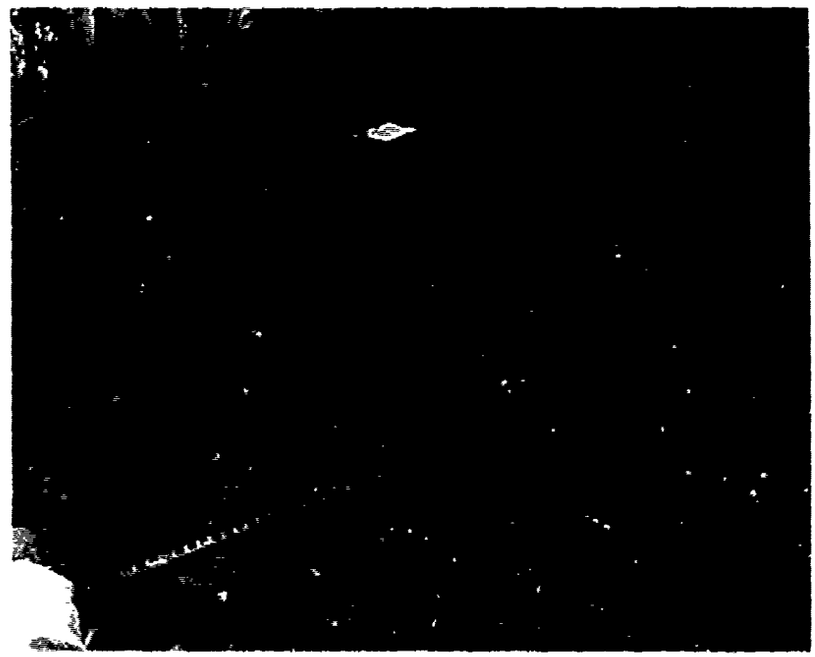


Photo 8 - Detail of left approach channel retaining wall showing erosion at its toe, mentioned above in Photo 7. (Photo taken on November 20, 1979)

Photo 9 - View of downstream channel, from spillway, showing retaining walls and the channel under West Brook Road. (Photo taken on November 20, 1979)

Photo 10 - Detail showing horizontal crack and seepage at the left retaining wall of the downstream channel. West Brook Road is across top-center. (Photo taken on November 20, 1979)

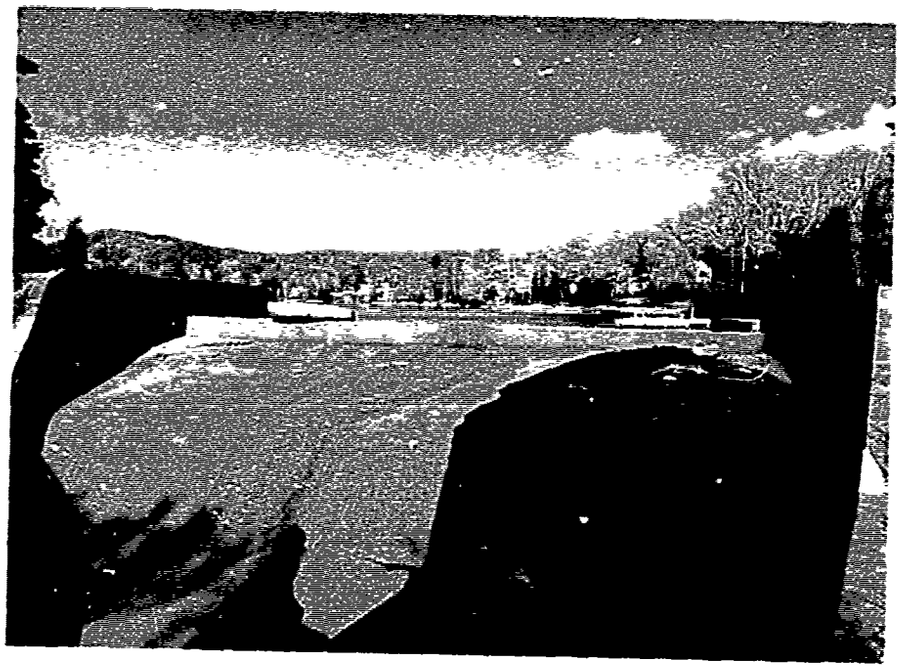


Photo 11 - View of spillway looking upstream. Note low level outlet drains in apron at bottom left and at right center. Also note completed repairs to right abutment mentioned in Photo 2. (Photo taken on January 21, 1980)

APPENDIX C

SUMMARY OF ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

Name of Dam: KITCHELL LAKE DAM

Drainage Area Characteristics: 0.86 square miles

Elevation Top Normal Pool (Storage Capacity): 796.0 NGVD (70 acre-feet)

Elevation Top Flood Control Pool (Storage Capacity): N/A

Elevation Maximum Design Pool: 799.42 NGVD (SDF pool: 149 acre-feet)

Elevation Top Dam: 800 NGVD (163 acre-feet)

SPILLWAY CREST:

a. Elevation 796 NGVD

b. Type Broad crest weir with shallow notch at center

c. Width 1 foot

d. Length 55 feet

e. Location Spillover Unknown as lake level down 6 feet

f. No. and Type of Gates None

OUTLET WORKS:

a. Type 2-12-inch C.I.P.

b. Location Center of spillway.

c. Entrance Inverts Upper 794.2 NGVD
Lower 786.0 NGVD

d. Exit Inverts Upper 794 NGVD
Lower 785.5 NGVD

e. Emergency Draindown Facilities Gate valve 12-inch dia. C.I.P.
Steel plate - 12-inch dia C.I.P.

HYDROMETEOROLOGICAL GAGES:

a. Type None

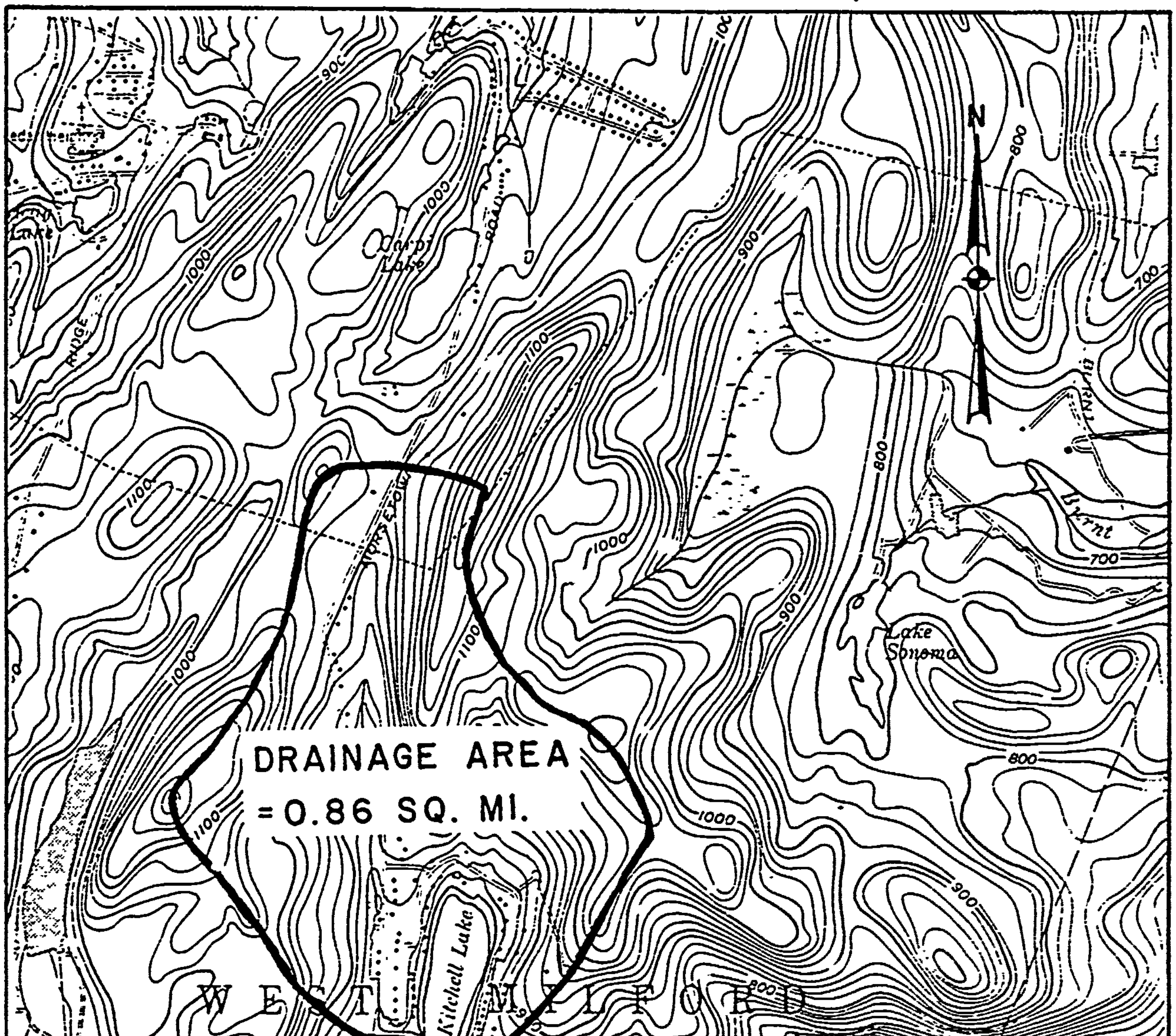
b. Location None

c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: 1,408 cfs at elevation 800 NGVD

APPENDIX D

HYDROLOGIC COMPUTATIONS



KITCHELL LAKE DAM
DRAINAGE BASIN

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT N.J. DAM SAFETY INSPECTION
KITCHELL LAKE DAM
COMPUTED BY C.L.C. CHECKED BY BK

SHEET NO. 1 OF 10
JOB NO. 10-A33-01
DATE 1-11-80

GROUP XVII

KITCHELL LAKE DAM (N.J. 00026)

SIZE CLASSIFICATION

Surface Area of Main Impoundment	22.04 Acres
Average Depth of Lake	7 Ft ±
Structural Height of Dam	14.3 Ft.
Size Classification	Small

HAZARD POTENTIAL CLASSIFICATION

Moderate Travelled Roadway with school bus Stop at D.S. of Dam

Hazard Potential	Significant
Recommended SDF	100 Yr

HYDROLOGIC ANALYSIS

Flood Routing will be computed by HEC-1 DB Program using SCS Triangular Unit Hydrograph with Curvilinear Transformation

D.A. = 0.86 sq. mi.

TIME OF CONCENTRATION

1) From velocity & water course lengths

	Slope %	Velocity (fps)	Remark
overland flow	$\frac{1180-940}{3600} = 6.7\%$	2.8	Woodland
Channel flow	$\frac{940-800}{4200} = 3.33\%$	3.0	Waterway

TIME OF CONCENTRATION (CONTINUED)

$t_c = (3600/2 + 4200/3)/3600 = 0.89$ HR.

2) From Channel velocity & Water course length:

$t_c = 7800/3(3600) = 0.72$ HR.

3) From Nomograph "Design of Small Dam," p.71

$\Delta H = 1180 - 800 = 390'$

$L = 7800'$

$S = 380/7800 = 4.9\%$

$t_c = 0.40$ HR.

4) Using FAA FORMULA for surface flow (Airport Drainage)

$T_c = 1.8(1.1-C)\sqrt{D}/S^{1/3}$

$= 1.8(0.8)\sqrt{7800}/(4.9)^{1/3}(60)$

$= 1.26$ HRS.

Use $T_c = 0.82$ HR.

$LAG = 0.6\ T_c$

$= 0.49$ HR.

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT N.J. Dam Inspection Program
Kitzhell Lake
COMPUTED BY BK CHECKED BY CLC

SHEET No. 3 OF 10
JOB No. 10-AX3-01
DATE 1/21/80

INFILTRATION DATA

Drainage Area consists most of HMG & GMX24K
HMO

Hydrologic Soil Group	C/D
Use initial infiltration	0.7 inch
use constant infiltration	0.07 in/hr

Ref. 'Engineering Soil survey of N.J.' Report NO.3;
Passaic County, Rutgers University, 1951

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT NJ Dom. Indep. Grp. 3 EIS
Kitchell Lake

COMPUTED BY FK CHECKED BY CLC

SHEET NO. 4 OF 10
JOB NO. 1C A83-01
DATE 3/6/86

Precipitation frequency values (inches) of 100 yr Storm

5	min	0.77	Ref. NOAA Tech Mem. NWS HYDRO-35 Circled values obtained by plotting.
10	min	(1.28)	
15	min	1.64	
30	min	(2.35)	
60	min	3.05	
2	hr	3.88	Ref. TP NO. 40
3	hr	4.35	
4	hr	4.73	
5	hr	4.98	
6	hr	5.20	

Kitchell Lake

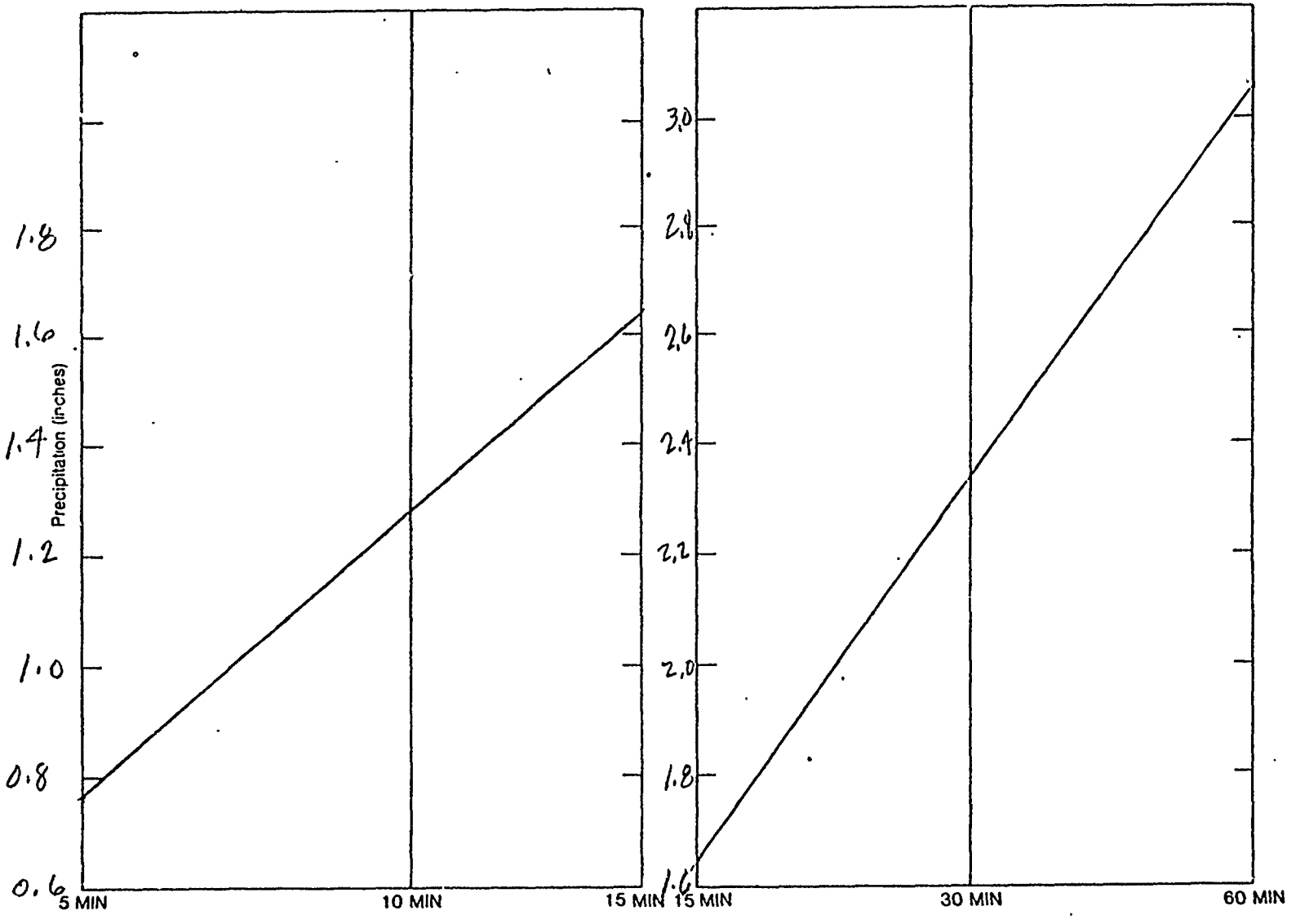
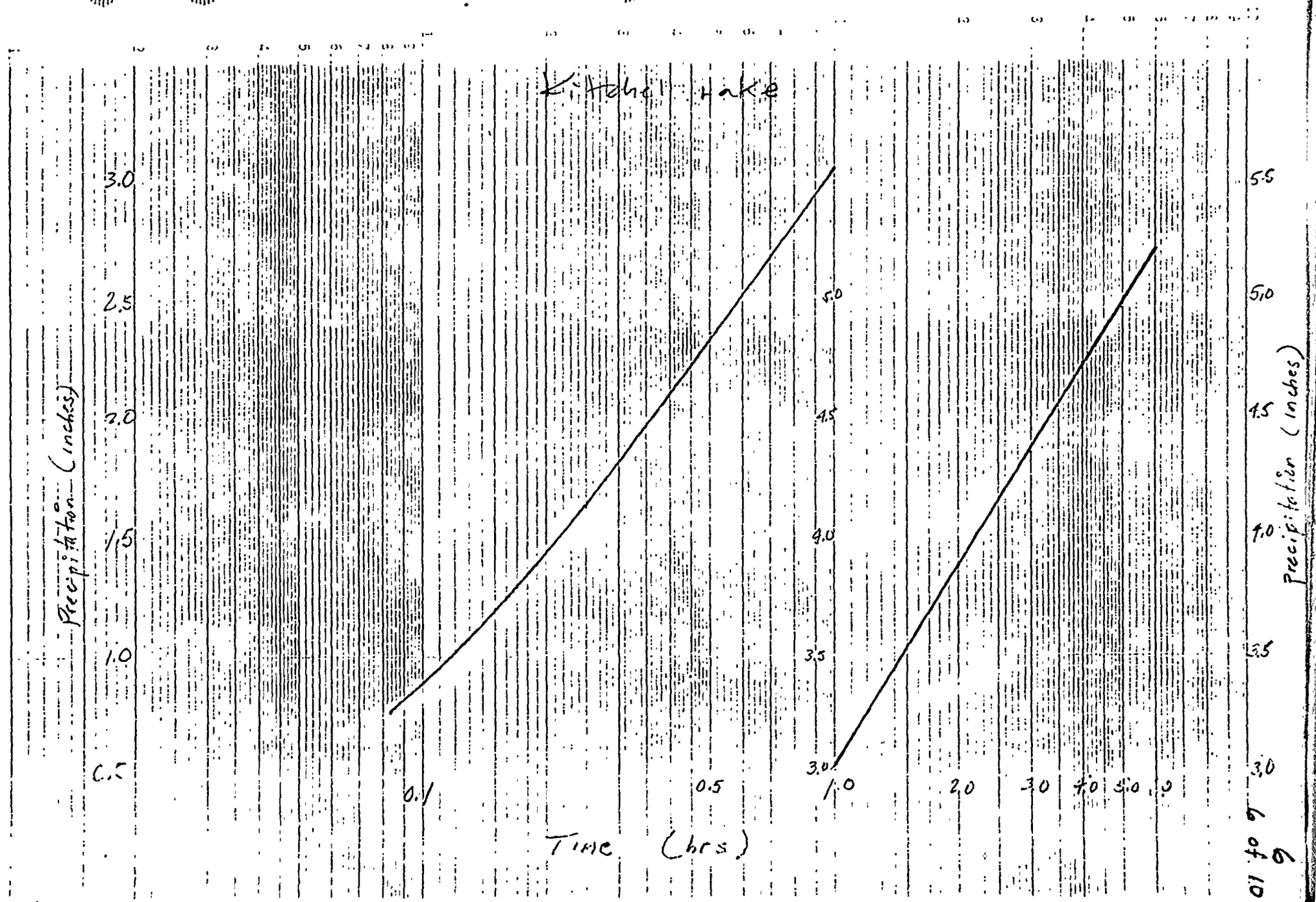


Figure 10.--Duration-interpolation diagram for 10- and 30-min estimates.

5 of 10


Lithel Lake
Precipitation (inches)
3.0
2.5
2.0
1.5
1.0
0.5
0.1
0.5
1.0
2.0
3.0
4.0
5.0
Time (hrs)
5.0
4.5
4.0
3.5
3.0
5.5
5.0
1.5
1.0
3.5
3.0
Precipitation (inches)

100-yr Rainfall Distribution

Time hr	Total Depth in	Incremental Depth in	Time hr	Total Depth in	Incremental Depth in
0.1	0.88	0.88	3.1	4.41	0.04
0.2	1.43	0.55	3.2	4.45	0.04
0.3	1.82	0.39	3.3	4.48	0.03
0.4	2.11	0.29	3.4	4.52	0.04
0.5	2.35	0.24	3.5	4.55	0.03
0.6	2.52	0.17	3.6	4.58	0.03
0.7	2.68	0.16	3.7	4.62	0.04
0.8	2.82	0.14	3.8	4.65	0.03
0.9	2.94	0.12	3.9	4.68	0.03
1.0	3.05	0.11	4.0	4.71	0.03
1.1	3.15	0.10	4.1	4.74	0.03
1.2	3.25	0.10	4.2	4.77	0.03
1.3	3.35	0.10	4.3	4.80	0.03
1.4	3.45	0.10	4.4	4.83	0.03
1.5	3.54	0.09	4.5	4.86	0.03
1.6	3.61	0.07	4.6	4.88	0.02
1.7	3.68	0.07	4.7	4.91	0.03
1.8	3.75	0.07	4.8	4.93	0.02
1.9	3.82	0.07	4.9	4.96	0.03
2.0	3.88	0.06	5.0	4.98	0.02
2.1	3.94	0.06	5.1	5.01	0.03
2.2	4.0	0.06	5.2	5.03	0.02
2.3	4.05	0.05	5.3	5.05	0.02
2.4	4.10	0.05	5.4	5.07	0.02
2.5	4.15	0.05	5.5	5.10	0.03
2.6	4.20	0.05	5.6	5.12	0.02
2.7	4.24	0.04	5.7	5.14	0.02
2.8	4.28	0.04	5.8	5.16	0.02
2.9	4.33	0.05	5.9	5.18	0.02
3.0	4.37	0.04	6.0	5.20	0.02

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT N.J DAM SAFETY INSPECTION / KITCHELL LAKE DAM — SHEET NO. 8 OF 10
JOB NO. 10-A83-01
COMPUTED BY C.L.C. CHECKED BY BK — DATE 1-11-80

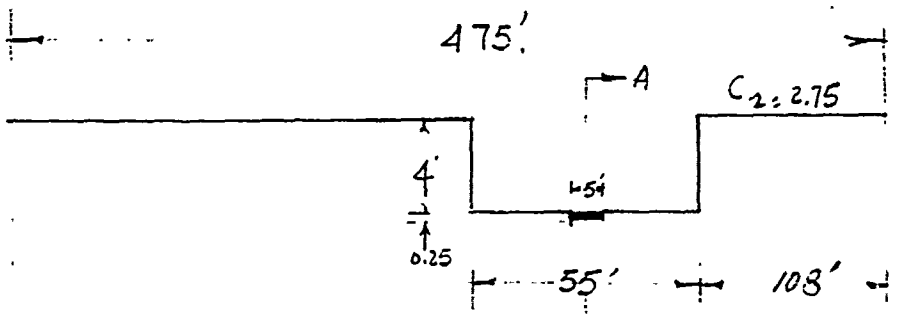
ELEVATION-AREA-CAPACITY RELATIONSHIP

Information obtained from U.S.G.S. map

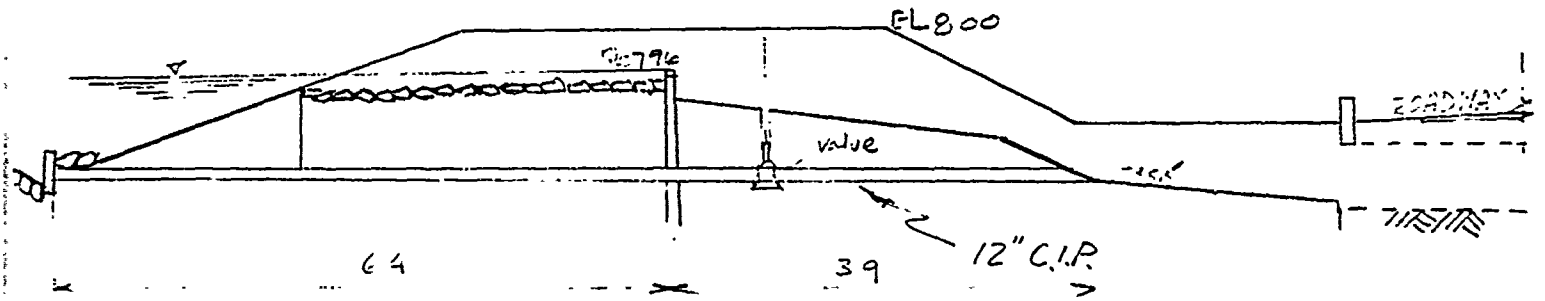
Ele.	786.5*	796	800	820	840
Surface Area	0	22.04	24.79	37.37	52.07

* Estimated bottom elevation of lake at spillway

HEC-1 DB PROGRAM will develope storage capacity from surface area and elevation



Ref. Table 5.3 King & Linsley



SECTION A-A

Drawdown computation

See section AA from Dg 4.

Assume $K_e = 0.5$, $K_{valve} = 0.19$ (fully open)

$G = 0.00085$ and complete turbulence

$\frac{G}{D} = 0.00085 \Rightarrow f = 0.0158$ (complete turbulence rough, pipe)

$H = \left(K_e + K_{valve} + \frac{fL}{D} + 1\right)\frac{V^2}{2g} = \left(0.5 + 0.19 + \frac{0.0158 \times 103}{1} + 1\right)\frac{V^2}{2g}$

$= 3.32\,\frac{V^2}{2g}$

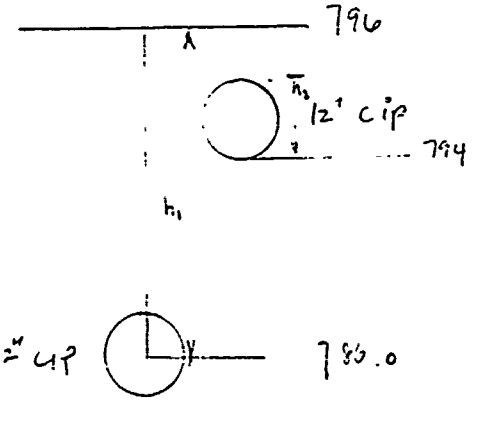
$\therefore V = 0.546\sqrt{2gh}$ (assume this formula is applicable for all heads)

$Q = VA = 0.546 \times \sqrt{2gh} = 3.44\sqrt{h}$

Assume water starts to drain @ Ele. of 796'

D.A. = 0.86 Sq mi

Inflow = 2 cfs/mi² = 1.70 cfs



From Elev 796 to 794 $Q = 3.44\sqrt{h_1} + 3.44\sqrt{h_2}$

$h_1 = 8.5$ $h_2 = 1$

$Q = 10 + 3.5 = 13.5$ cfs

From Elev 794 to Elev 786.5

$Q = 3.44\sqrt{h}$

For simplification, Assume T.W. @ half depth of outlet

$= 786 + 0.5 = 786.5$

Drawdown computation - continued

Res Ele	Area Ac	Ave Area Ac	Vol. Ac-ft	Av Res El	Q Ave. Outlet Q=3.4H^1.5 (10 to 3.5 -13.5)	t_1 hr time of Drawdown $\frac{Vol \times 24}{1.98 \times Q}$	cul time hr	t_2 time of Drawdown with inflow $1.7 \times \frac{t_1}{Q}$	cul time t_{12} hrs
796	22.0								
		17.65	35.7	795	31.7	31.7	4.0	45.7	
794	13.3								
		10.25	21.2	793	8.8	28.2	59.9	5.5	69.9
792	7.2								
		5.10	10.2	791	7.3	16.9	76.8	3.9	90.2
790	3.0								
		1.8	3.6	789	5.4	8.1	84.9	2.6	100.9
788	0.6								
		0.3	0.45	787.3	3.0	1.8	86.7	1.0	103.7
786.5	0								

A) Time of complete drawdown with no inflow = 86.7 hrs ≈ 4 days

B) Time of complete drawdown with inflow = 103.7 hr ≈ 4 days

$$A_1 = \frac{A_2}{\left(\frac{h}{H_T} + 1\right)^2}$$

$h + H_T = 9.5'$ $A_2 = 22$ acres

```
A1                N J DAM SAFETY INSPECTION PROGRAM---GROUP XVII  10A8301
A2                N J 00026 KITCHELL LAKE, PASSAIC COUNTY, NJ
A3                100 YEARS ROUTING,PRC-HARRIS INC., WOODBRIDGE, N J
B       80        0       6                                 0       0       3
I1       3
K        0    LAKE                              0       0       1
K1                INFLOW HYDROGRAPH THROUGH KITCHELL LAKE
N                    2     .86                 .86
O        60
O1    0.03    0.03    0.03    0.03    0.03    0.03    0.04    0.04    0.04    0.04
O1    0.04    0.04    0.04    0.05    0.05    0.05    0.05    0.05    0.06    0.06
O1    0.06    0.07    0.07    0.07    0.07    0.09    0.10    0.10    0.10    0.10
O1    0.88    0.55    0.39    0.29    0 24    0.17    0.16    0.14    0.12    0.11
O1    0.03    0.03    0.03    0.03    0.03    0.03    0.03    0.03    0.03    0.02
O1    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02
I                                                     0.7     0.07
P2               0.49
X       -1    -.05       2                                .
K        1     DAM                              0       0       1
K1                ROUTING DISCHARGE THROUGH DAM
Y                                         1       1
Y1       1                                                -796.0       0
*A       0    22.0    24.5    37.4    52.1
*E   786.5     796     800     820     840
**   796.0      55     3.2     1.5
*D     800    2.75     1.5     420
K       99
A
A
A
A
A
A
```

N J DAM SAFETY INSPECTION PROGRAM---GROUP XVII 10A8301
N J 00026 KITCHELL LAKE, PASSAIC COUNTY, NJ
100 YEARS ROUTING,PRC-HARRIS INC., WOODBRIDGE, N J

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
80	0	6	0	0	0	0	0	3	0
			JOPER	NWT	LKOPT	TRACE			
			3	0	0	0			

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH THROUHG KITCHELL LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	2	.86	0.00	.86	0.00	0.000	0	0	0

PRECIP DATA

NP	STORM	DAJ	DAK
60	0.00	0.00	0.00

PRECIP PATTERN

.03	.03	.03	.03	.03	.03	.04	.04	.04	.04
.04	.04	.04	.05	.05	.05	.05	.05	.06	.06
06	.07	.07	.07	.07	.09	10	.10	.10	0
88	.55	.39	.29	.24	.17	16	.14	.12	.11
03	.03	.03	.03	.03	.03	.03	.03	.03	.02
.02	.02	.02	.02	.02	.02	.02	.02	.02	.02

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	.70	.07	0.00	0.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .49

RECESSION DATA

STRTQ= -1.00 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 27 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .49 VOL= 1.00

69.	211.	442.	665.	763.	756.	663.	537.	379.	276.
205.	154.	112.	83.	62.	45.	34.	25.	19.	14.
10.	8.	6.	4.	3.	1.	0.			

MO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.06	1	.03	0.00	.03	1.	1.0	4.06	41	.03	.02	.01	1231.
1.01	.12	2	.03	0.00	.03	1.	1.01	4.12	42	.03	.02	.01	1072.
1.01	.18	3	.03	0.00	.03	1.	1.01	4.18	43	.03	.02	.01	914.
1.01	.24	4	.03	0.00	.03	1.	1.01	4.24	44	.03	.02	.01	763.
1.01	.30	5	.03	0.00	.03	1.	1.01	4.30	45	.03	.02	.01	625.
1.01	.36	6	.03	0.00	.03	1.	1.01	4.36	46	.03	.02	.01	505.
1.01	.42	7	.04	0.00	.04	1.	1.01	4.42	47	.03	.02	.01	409.
1.01	.48	8	.04	0.00	.04	0.	1.01	4.48	48	.03	.02	.01	334.
1.01	.54	9	.04	0.00	.04	0.	1.01	4.54	49	.03	.02	.01	280.
1.01	1.00	10	.04	0.00	.04	0.	1.01	5.00	50	.02	.01	.01	240.
1.01	1.06	11	.04	0.00	.04	0.	1.01	5.06	51	.02	.01	01	208.
1.01	1.12	12	.04	0.00	.04	0.	1.01	5.12	52	.02	.01	.01	182.
1.01	1.18	13	.04	0.00	.04	0.	1.01	5.18	53	.02	.01	.01	160.
1.01	1.24	14	.05	0.00	.05	0.	1.01	5.24	54	.02	.01	.01	140.
1.01	1.30	15	.05	0.00	.05	0.	1.01	5.30	55	.02	.01	.01	123.
1.01	1.36	16	.05	0.00	.05	0.	1.01	5.36	56	.02	.01	.01	110.
1.01	1.42	17	.05	0.00	.05	0.	1.01	5.42	57	.02	.01	.01	98.
1.01	1.48	18	.05	.01	.04	1.	1.01	5.48	58	.02	.01	.01	91.
1.01	1.54	19	.06	.05	.01	6.	1.01	5.54	59	.02	.01	.01	85.
1.01	2.00	20	.06	.05	.01	19.	1.01	6.00	60	.02	.01	.01	81.
1.01	2.06	21	.06	.05	.01	44.	1.01	6.06	61	0.00	0.00	0.00	78.
1.01	2.12	22	.07	.06	.01	81.	1.01	6.12	62	0.00	0.00	0.00	73.
1.01	2.18	23	.07	.06	.01	123.	1.01	6.18	63	0.00	0.00	0.00	68.
1.01	2.24	24	.07	.06	.01	167.	1.01	6.24	64	0.00	0.00	0.00	64.
1.01	2.30	25	.07	.06	.01	208.	1.01	6.30	65	0.00	0.00	0.00	59.
1.01	2.36	26	.09	.08	.01	244.	1.01	6.36	66	0.00	0.00	0.00	55.
1.01	2.42	27	.10	.09	.01	276.	1.01	6.42	67	0.00	0.00	0.00	52.
1.01	2.48	28	.10	.09	.01	307.	1.01	6.48	68	0.00	0.00	0.00	48.
1.01	2.54	29	.10	.09	.01	341.	1.01	6.54	69	0.00	0.00	0.00	45.
1.01	3.00	30	.10	.09	.01	374.	1.01	7.00	70	0.00	0.00	0.00	42.
1.01	3.06	31	.88	.87	.01	459.	1.01	7.06	71	0.00	0.00	0.00	39.
1.01	3.12	32	.55	.54	.01	628.	1.01	7.12	72	0.00	0.00	0.00	37.
1.01	3.18	33	.39	.38	.01	915.	1.01	7.18	73	0.00	0.00	0.00	34.
1.01	3.24	34	.29	.28	.01	1263.	1.01	7.24	74	0.00	0.00	0.00	32.
1.01	3.30	35	.24	.23	.01	1555.	1.01	7.30	75	0.00	0.00	0.00	30.
1.01	3.36	36	.17	.16	.01	1736.	1.01	7.36	76	0.00	0.00	0.00	28.
1.01	3.42	37	.16	.15	.01	1784.	1.01	7.42	77	0.00	0.00	0.00	26.
1.01	3.48	38	.14	.13	.01	1724.	1.01	7.48	78	0.00	0.00	0.00	24.
1.01	3.54	39	.12	.11	.01	1570.	1.01	7.54	79	0.00	0.00	0.00	22.
1.01	4.00	40	.11	.10	.01	1398.	1.01	8.00	80	0.00	0.00	0.00	21.
									SUM	5.20	4.20	1.00	23758.
										(132.)	(107.)	(25.)	(672.75)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1784.	395.	297.	297.	23748.
CMS	51.	11.	8.	8.	672.
INCHES		4.28	4.28	4.28	4.28
MM		108.63	108.74	108.74	108.74
AC-FT		196.	196.	196.	196.
THOUS CU M		242.	242.	242.	242.

HYDROGRAPH ROUTING

ROUTING DISCHARGE THROUGH DAM

ISTAQ	ICOMP	IECL	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-796.	0

SURFACE AREA=	0	22.	25.	37.	52.
CAPACITY=	0	70	163	777	1668.
ELEVATION=	787	796	800.	820.	840.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
796.0	55.0	3.2	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
800.0	2.8	1.5	420

MAXIMUM OUTFLOW IS 1114 AT TIME 4.20 HOURS

15 of 15 (5 of 5)

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RUNOFF SUMMARY, AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES(SQUARE KILOMETERS)

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	LAKE	1784.	395.	297.	297.	.86
		(50.52)(	11.20)(	8.41)(	8.41)(	2.23)
ROUTED TO	DAM	1114.	370.	277.	277.	.86
		(31.54)(	10.48)(	7.86)(	7.86)(	2.23)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	796.00	796.00	800.00
STORAGE	70.	70.	163.
OUTFLOW	0.	0.	1408.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.00	799.42	0.00	149.	1114.	0.00	4.20	0.00

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****